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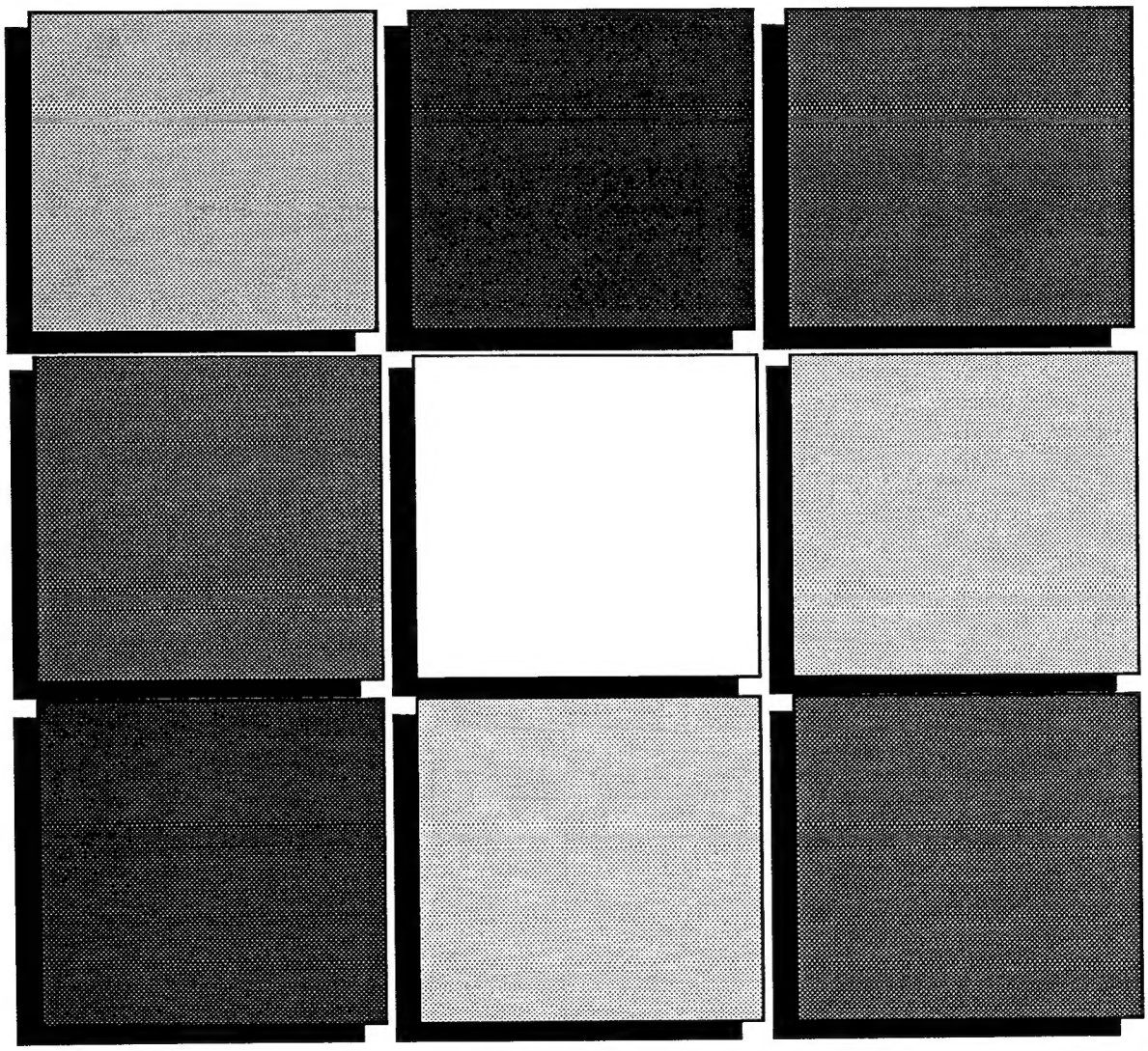

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Ventura Educational Systems

3440 Brokenhill Street
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GeoArt: Geometry/Art Discovery Unit

For Apple // Series Computers
Version 2.0

Ventura Educational Systems

GeoArt: Geometry/Art Discovery Unit

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GeoArt
A Geometry/Art Discovery Unit

GeoArt is a collection of educational programs dealing with the relationship between geometry and art. This learning system includes a Shapes Game, Perimeter and Area Drills, a Transformations program and a Design program with a variety of options. Each program explores topics pertaining to geometry and art. The student who uses the program will develop a broader understanding of the relationship between mathematics and art.

GeoArt is a uniquely different program that explores the interesting and beautiful relationship between mathematics and art. The program has been specifically designed for Apple computers. Many aspects of GeoArt take advantage of color graphics. The learning system is tutorial in parts and also encourages creative expression in other parts. GeoArt explores many areas of mathematics and art, but in no way does it encompass all areas that could be explored. This teacher's guide is meant to be a starting point for understanding the use of the program. The guide suggests ways to use the program in a classroom setting. The creative teacher who uses GeoArt will undoubtedly think of many other ways to use the program.

Using the Computer in the Study of Geometry and Art

The microcomputer is an exciting tool that offers to teachers many new and different approaches to the study of traditional material.

A student's use of GeoArt can be highly interactive. The computer is used for expression of creative ideas. Because the use of GeoArt encourages experimentation and manipulation, the student develops artistic sensibilities by evaluating many different combinations of shapes and colors. Some menu choices lead to tutorial activities, others lead to explorations of geometrical and artistic concepts. As with any type of media, the more familiar that an individual is with the use of the media, the easier it is to be truly creative.

GeoArt: Geometry/Art Discovery Unit
Credits

Software Design	**Ventura Educational Systems**
Instructional Technology and Programming	**Fred Ventura, Ph.D.**
Editor	**Marne Ventura, M.A.**

Dr. Fred Ventura is an experienced classroom teacher and has taught elementary, secondary and college levels. He holds a doctorate in education from the University of California, and presents workshops for educators on the instructional uses of microcomputers.

Marne Ventura is also an experienced classroom teacher and holds a masters degree in reading and language development from the University of California. As a seminar leader, Marne Ventura has assisted many teachers in learning about the educational opportunities that can be derived from the use of microcomputers in the classroom.

Other Publications Include:

SuperGraph
States: Geography Study Unit
Marine Life: Anatomy of a Fish
Anatomy of a Sea Lamprey
Senses: Physiology of the Human Sense Organs
The Plant: Nature's Food Factory
Chemaid: Introduction to the Periodic Table
The Worm: Invertebrate Anatomy
Protozoa: Introduction to Microorganisms
Computer Concepts
All About the Solar System
All About Simple Machines
Dr. Know: Experiments in Artificial Intelligence
Coordinate Geometry
Geometry Concepts
Marine Invertebrates
Anatomy of a Shark
VisiFrog: Vertebrate Anatomy
Music Concepts
Plant and Animal Cells
The Insect World
All About Matter
All About Light & Sound

Reproducible Pages and Additional Program Disks

Supplementary materials are provided in this manual. These materials are designed to be used in conjunction with the hands on computer activities. The supplementary worksheets may be duplicated for classroom use.

Many schools have more than one computer and to effectively use educational software require additional legal copies of a program. Additional program disks are available to more effectively use this program in a computer lab. The price is $10.00 per disk. Any school with a registered copy of any Ventura Educational Systems product may order additional copies of a program disk at any time. There is a 30 day warranty on original program disks. If for any reason a program disk becomes defective within 30 days of the date of purchase, Ventura Educational Systems will replace it at no charge.

Program Objectives

GeoArt explores a variety of topics and can be used creatively by teachers in many different ways. Below is a list of some of the objectives that can be addressed with the program:

1. To correctly identify and spell the names of eight basic shapes and to develop an understanding of how these shape might be used in design.

2. To provide practice in calculating the perimeter and area of basic shapes.

3. To explore the transformation, rotation and reflection of simple shapes.

4. To experiment with elements of design.

Recommended Grades	4-8
Curriculum Areas	Geometry Art General Math
System Requirements	Apple // Series Computer - 1 Disk Drive 48K RAM (minimum) Color Monitor (recommended)

GeoArt: Geometry/Art Discovery Unit

The GeoArt Conceptual Framework

Mathematics and art are inextricably related. Even in the earliest cave paintings we can find examples of the prehistoric artist using proportions, lines and angles. Greek and Roman art provide rich examples of the link between mathematics and art. Thoughout art history great works of art can be studied mathematically.

Symmetry and proportion are two qualities that can be investigated both mathematically and artistically. These concepts are employed in painting, sculpture, music and architecture. GeoArt allows the user to explore symmetry and proportion with the assistance of the computer. The user can gain a better understanding of symmetry, proportion and other aspects of the geometry/art relationship with this program.

A person's ability to create and appreciate art can be developed. Without attempting to be overly analytical, GeoArt allows the user to "play with" mathematical concepts and investigate their relationship to art in his or her own way. The activities included in this manual help to direct the exploration and hopefully will serve as a starting point for further investigation.

Many of the programs use the random number generator to create shapes and select colors. These programs will result in exciting, unpredictable patterns and color combinations and because of this can be used as a step toward enhancing personal creativity. The use of GeoArt is meant to be enjoyable and to encourage artistic exploration and curiosity about mathematics and art.

Starting the Program

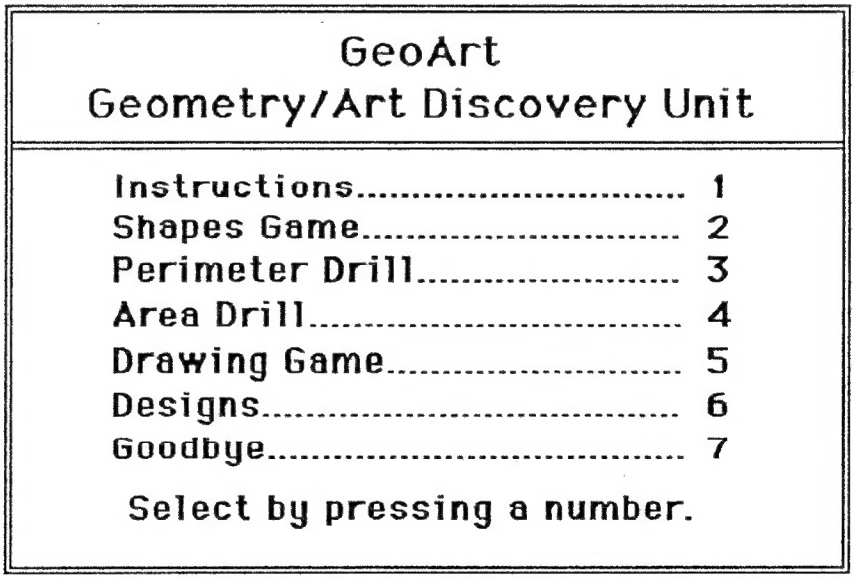
The program disk included with this product can be used on a single computer. To start the program insert the program disk in the primary drive and turn the power on or if the system is already on, use the CTRL-Open Apple-RESET method to reboot the system. Please consult the Apple Owner's Manual for more complete instructions on how to properly use the computer.

Note: Periodically during the use of this program the computer will access information from the program disk. Therefore, do not remove the program disk from the disk drive while the program is in use.

After booting the program disk, a title screen is displayed. Press any key to advance to the GeoArt menu.

Organization of the Program

All of the activities provided for in the GeoArt program are accessed from menus. The main menu is titled the GeoArt Geometry/Art Discovery Unit Menu and leads the user to an activity or to another menu. Press the number corresponding to a choice to select from the menu. Use ESC, the escape key, to return to this menu.



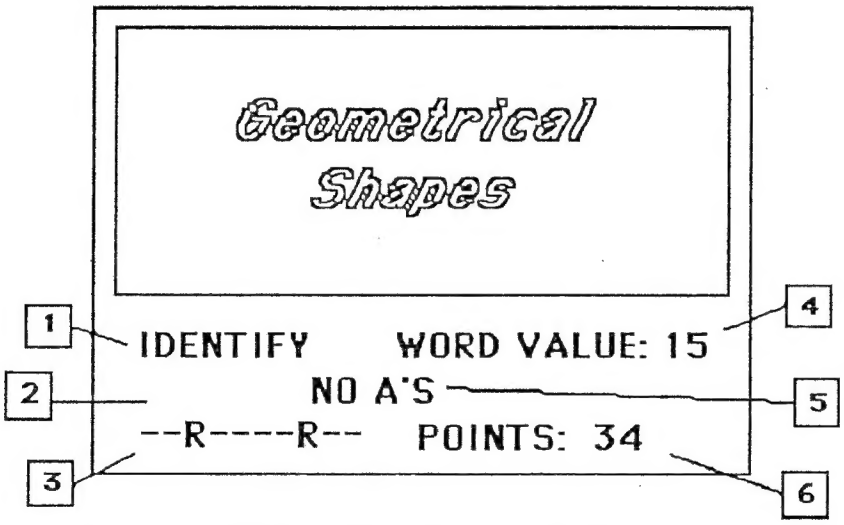
Special Note: Two different character sets are provided in this program. When the main menu screen is showing, Press the letters A or B to switch character sets.

Shapes Game

The Shapes Game is an educational program designed to teach the recognition of basic shapes and the spelling of the names of the shapes. The program presents information about the special characteristics of eight common shapes.

After selecting Shapes Game from the main menu, a picture screen is presented. During the game a flashing cursor will indicate one of the eight shapes. The object of the game is to correctly spell the name of each shape. Each correctly guessed vowel earns one point. Correct consonants earn three points. Each incorrect guess results in the loss of one point. The score, however, will not go below zero. If the student is unfamiliar with the names of the basic shapes, he or she should use a letter guessing strategy to identify the shape. If the student knows the name of the shape, press the key marked [?/] to enter the entire word. 10 bonus points are earned for spelling a term correctly using the [?/] option.

Specific areas of the screen that are used during the Shapes Game:



1. Instructions describing what the user is to do.
2. Input area where complete term is entered and bonus points are earned.
3. Blanks show length of term and position of correct letters.
4. Total points possible for the current term. (1 point for each vowel, and 3 points for each consonant.)
5. Message area for incorrect and repeated guesses.
6. Total number of points earned for this game.

Identifying Geometric Shapes

The object of the Identification Game is to provide practice in identifying and spelling the names of geometric shapes. If the user is unsure of the name of the shape that is being indicated, the Letter Entry mode should be used to guess letters. If the indicated shape is known, the Full Word Entry mode should be used in order to get 10 bonus points.

Letter Entry

To guess a letter in the name of the indicated shape, press a letter key. If the letter is in the word, the position(s) of the letter will be shown in the blank line. If the letter is incorrect a message will state that the word does not contain the letter. One point is deducted for each incorrect letter. If a letter is attempted that has already been played correctly the message: "IT'S THERE" is displayed.

Full Word Entry

To enter the complete word without any letter guesses press the [/?] key. This can only be done if no letter guesses have been attempted for the current term. Ten bonus points are earned for identifying a term correctly without taking any letter guesses.

Information Screen

When a geometric shape has been identified the function of the part is displayed briefly and then an information screen is shown. Read the information presented about the shape and then press the SPACEBAR to resume the game.

End of the Shapes Game

To end the game before identifying all the shapes, press the ESC key. When all the shapes have been identified the game ends and final score is given. Press the RETURN key for the program to return to the menu.

Perimeter Drill

The Perimeter Drill provides practice in finding the perimeter of triangles, squares and rectangles. After reading the instructions press any key to start the drill.

The drill is designed to focus the student on solving a problem using the standard formula for computing perimeter. It is appropriate to use paper and pencil or a calculator to solve the problems presented by this program. The object of the program is to correctly answer ten problems. To stop the program before answering ten problems correctly enter "Q" as an answer to a problem.

Area Drill

The Area Drill provides practice in finding the area of triangles, squares and rectangles. Select number 4 from the Geoart menu to start the program. After reading the instructions that are displayed on the screen, press any key to start the drill.

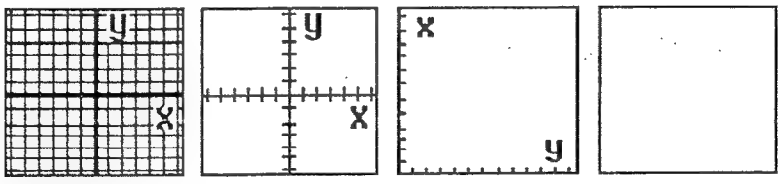
The drill is designed to focus the student on using the standard formula for computing area. Paper and pencil or a calculator may be appropriate for the student to use to solve the problems presented by this program.

The object of the program is to correctly answer ten problems. To stop the program before ten problems are answered correctly enter "Q" as an answer to a problem.

Transformations

Transformations is an exciting tool for exploring geometric transformations, specifically translations, rotations, and reflections. The program can be used in a variety of ways. As a playful activity for generating designs, the program stimulates creativity. The program can also be used to pose problems that help to develop visual thinking.

The first prompt will ask the user to select a background for the drawing. The choices for type of screen are Grid, Ticks, Quadrant I, or Hidden X and Y Axes. For instructional purposes as a figure is created, the coordinates of the drawing point are shown relative to the type of screen selected. If Hidden X and Y Axis is selected the coordinates are not shown. The options Grid, Ticks, and Quadrant I are useful when exploring the mathematics of transformational geometry. Hidden X and Y Axes is useful for studying the aesthetic application of transformational geometry in design.



Grid Ticks Quadrant I Hidden X and Y Axis

Next, the user must enter a length for the line segments that will be drawn when creating the design. All line segments are the same. The range for the length of line segments is different and based on the type of background selected

Vertical Translation (V)

Selecting vertical translation refers to moving every point in the figure up or down. When vertical translation is selected, the user is prompted to enter the number of points that the figure is to be translated. Positive or negative integers can be entered, but values that move the figure off the screen are not accepted. Enter a zero to cancel the vertical translation without affecting the figure. A vertical translation is represented by the components shown below:

Under the translation $\begin{pmatrix} 0 \\ 5 \end{pmatrix}$, the point (3,4) goes to (3+0,4+5) or (3,9).

Horizontal Translation (H)

The horizontal translation command option moves the figure laterally. When this command is selected the user is prompted to enter the number of points for the figure to be translated. Values can be positive or negative. Positive values move the figure to the right. Negative values move the figure to the left. Values which would move the figure off the screen are not accepted.

Under the translation $\begin{pmatrix} 2 \\ 0 \end{pmatrix}$, the point (3,4) goes to (3+2,4+0) or (5,4).

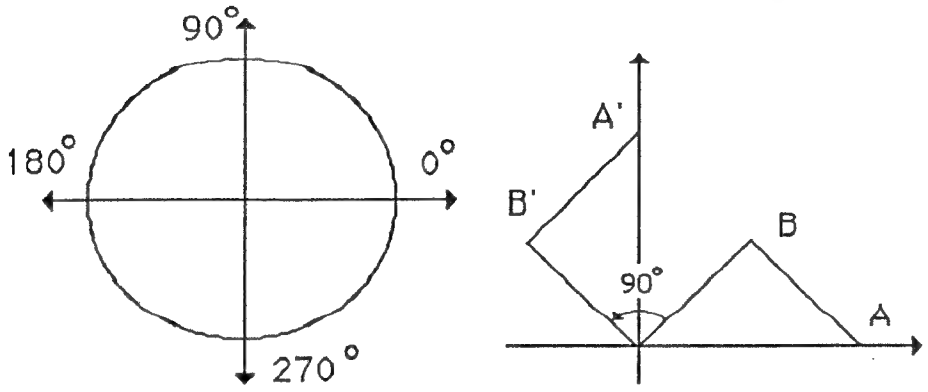
Horizontal and Vertical Translation (B)

The 'B' command allows the figure to be translated <u>both</u> vertically and horizontally.

The image of any point (a,b) under a translation $\begin{pmatrix} x \\ y \end{pmatrix}$ is the point (a+x,b+y).

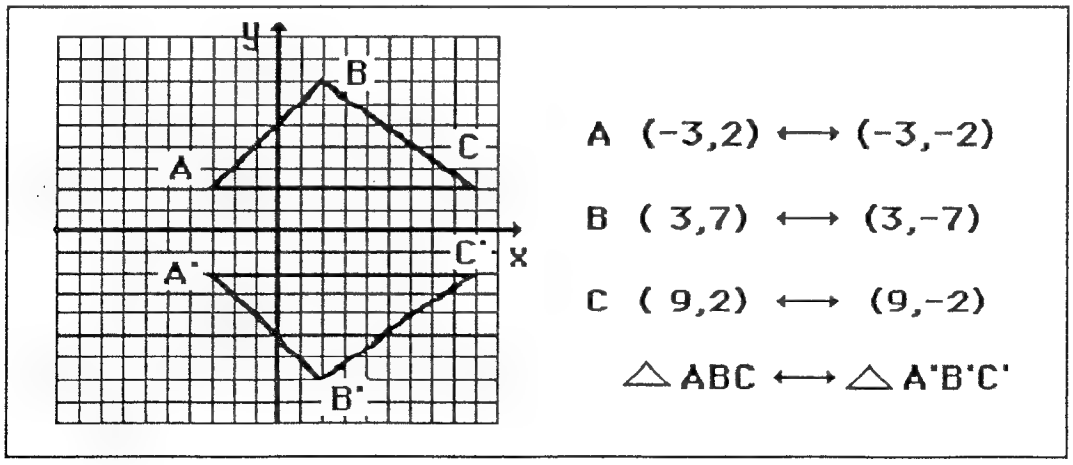
Rotation (R)

Another type of transformation that can be performed on a figure is a rotation. Using the Translation Program figures can be easily rotated. The program allows for 90, 180 and 270 degree rotations. Press 'R' to rotate a figure and the computer will request the number of degrees for the rotation. If the word 'all' is entered the program will rotate the figure 90, 180 and 270 degrees.



Reflection in X (X)

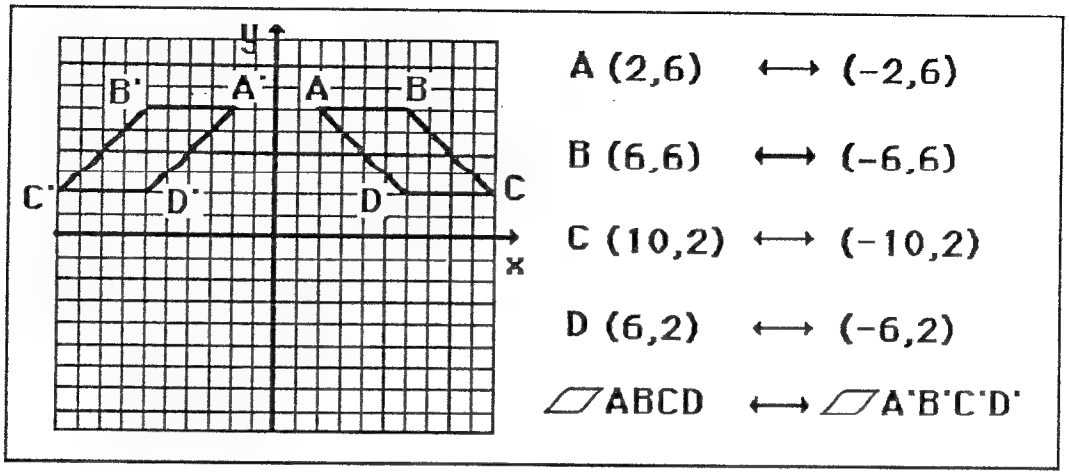
The axes of the Cartesian plane can be used to reflect a figure. The diagram below illustrates the mapping of a reflection in the X-axis of a triangle. A mapping of a figure given by the reflection in the x-axis associates every point **P(a,b)** with its image **P'(a,-b)**.



Note: Under a reflection, the shape and its image are congruent.

Reflection in Y (Y)

The transformation of a figure by reflection in Y is similar to reflection in X. Under a transformation where the figure is reflected in the y-axis the mapping shown below occurs.



Reflection in X and reflection in Y are not activated when screen option 3, Quadrant I, is selected, since the resulting figures would be off the screen.

Clear Screen (C)

The Clear Screen option clears the screen but preserves the length and screen option parameters. This option allows the user to draw a new figure using the same basic setup.

Set Length (L)

The Set Length command preserves the selected screen option but allows the length to reset and starts the drawing over.

Move Drawing (M)

The Move Drawing option allows the user to move the drawing to a new location. Use the arrow keys or I, J, K, and M to move the drawing. Press return to select a new location.

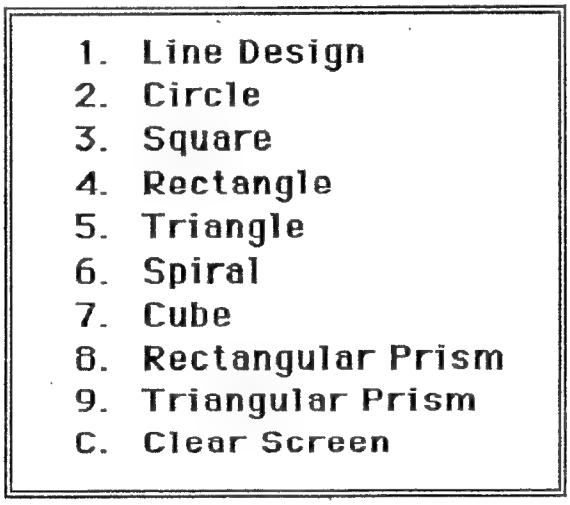
Designs

The Designs program is selected from the Main Menu and begins by presenting textual information about each of the activities available from the Design Program Menu. Press the SPACEBAR to continue reading the descriptions and answer 'y' or 'n' to the sound option.

The Designs program options allow the user to continue exploring the relationship between geometry and art through a variety of new topics.

Designs --- Drawing Machine

The Drawing Machine is a tool for exploring geometric figures, shapes and proportion. To activate the program, select option 1 from the Designs Program Menu. Read the brief instructions and press the SPACEBAR to continue. The drawing options for the Drawing Machine menu are then presented.



Line Design

The Line Design, option #1, creates a design based on the Cartesian plane. First position the origin or center of the Cartesian plane using the directional control keys (either the arrows or I, J, K and M). After the starting point is positioned the computer prompts the user to enter the size of the step. This refers to the number of points between each line. Try a 4 or a 5.

The design is created by connecting points along the x and y axes and is an example of symmetry, and also of a curved shape created from straight lines.

Circle

Option #2 from the menu causes a circle to be drawn. After locating the center of the circle, the computer prompts the user to enter a radius. The largest radius possible is based on where the center of

the circle has been positioned. Once the radius has been entered the circle will be drawn on the screen.

Square

A square can be drawn using option #3. To draw a square, position the top left corner of the square. Then enter the length of a side and press return.

Rectangle

A rectangle can be drawn by choosing option #4. The user is asked to position the top left corner and enter the dimension of the rectangle.

Triangle

To draw a triangle select option #5. Position the top vertex of the triangle and enter the dimensions.

Spiral

A spiral, option #6, is drawn from the outer part of the screen toward the center. For the spiral a starting radius is entered and a factor by which the radius is decreased. The spiral can be set to turn from the right or left. A negative radius (which of course is rather strange, but mathematically possible on the computer) causes the spiral to begin on the opposite side and increase in size.

Cube

To automatically draw a cube on the screen select option #7. Position the front, top, left vertex of the cube and press return. Enter the length of the side and press return.

Rectangular Prism

The rectangular prism, option #8, is drawn by first positioning the front, top, left vertex and then entering the dimensions.

Triangular Prism

A triangular prism, option #9, can be drawn by positioning the vertex of the front, top, triangular face, and entering the dimensions.

Clear Screen

To erase the screen and start a new drawing press C. To quit the drawing machine program and return to the Designs Menu press the escape key.

Designs -- Kaleidoscopes

The Kaleidoscopes programs create designs by reflecting points and lines. Each program is different and entertaining.

Diamond Back

The Diamond Back kaleidoscope allows the user to select the colors to be used in developing the design. It is useful as a tool for comparing the artistic quality of certain color combinations.

Wandering Colors

This kaleidoscope creates an interesting design by reflecting in four directions a randomly moving color point. The computer completely generates the design.

Windows

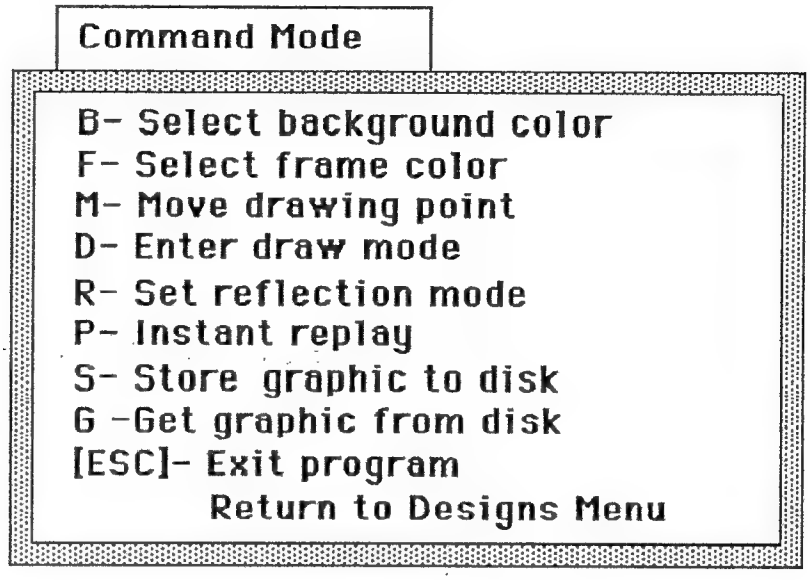
This design is randomly generated by the computer. The design is based on rectangles. The use of color in the design can be explored and has a three-dimensional effect.

Hi-Res Kaleidoscope

In this kaleidoscope the computer randomly positions lines which are reflected to create a dramatic design.

Designs --- Drawing Pad

The Drawing Pad is a low resolution drawing utility that allows the user to control the computer in creating colorful graphics. After selecting the Drawing Pad from the menu a blank screen is displayed with the words Command Mode shown below a white bar. Different keys are active in each mode. In the command mode these options are available:

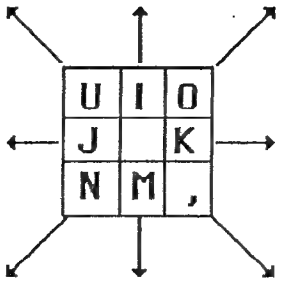


The 'B' command allows a background color to be set for the graphic. After selecting 'B', the available colors will appear at the bottom of the screen with a small indicator pointing to black. Select a background color by pressing the arrow keys to move the indicator to the desired color and press return to choose. This command is also used to erase the screen and start the drawing over.

The 'F' command causes a frame to be drawn around the graphic. Select a color for the frame by moving the indicator and pressing return.

The 'M' or move command is used to locate the starting point of the drawing or to relocate the drawing point. It is like lifting the pen.

To start drawing, select 'D' from the command mode. In the draw mode, the keys shown below are active and cause the drawing point to move in the direction indicated. Press 'C' in the draw mode to choose another color and press [ESC] to leave the drawing mode and return to the command mode.



The 'R' option from the command mode allows the user to select a type of reflection to be used in the drawing. The options for reflection are as follows:

1 - Horizontal	3 - Both
2 - Vertical	4 - None

If option 1, horizontal reflection, is used, the drawing is mirrored horizontally across an imaginary line in the middle of the screen. Option 2, vertical reflection, causes mirrored drawings across an imaginary line drawn laterally through the middle of the screen. Both, option 3, causes mirroring to take place both vertically and horizontally. To cancel the reflection mode choose option 4, None.

After a drawing has been created, return to the command mode by pressing the escape key, ESC, and press P for an instant replay of the drawing process.

The 'S' command allows the user to save the drawing on a storage disk. Enter the name of the design and press return. The extension ".PIC" is added to the file name for identification.

To retrieve a stored picture, enter the command 'G' for get and enter the name of the design. It is not necessary to add the ".PIC" extension to the filename.

Press the escape key, ESC, from the command mode to return to the Design Menu.

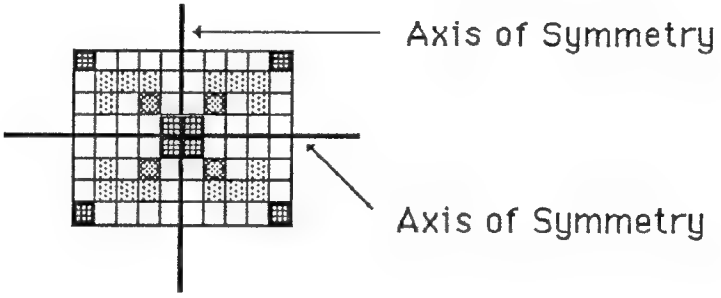
Tessellations

A tessellation is a design in which the elements are carefully positioned to form a coherent pattern. The Tessellations option from the Designs menu leads the user to the exploration of a variety of tessellations. Some of these tessellations are randomly produced by the computer. Others are designed by the user. All are interesting.

Computer Quilt

The first tessellation program is called Computer Quilt because it produces a quilt-like pattern on the screen. The program continuously generates designs and is stopped by pressing any key.

To start generating a design enter a size for the pattern that is between 2 to 38 cells. For an interesting design begin by selecting a size of 9 or 10. Next the computer will ask if symmetry is to be used in the design. If symmetry is selected the computer will generate a design where each block has two axes of symmetry. (Even if symmetry is not selected, since the design is randomly generated there is a small probability that the computer will generate a symmetrical design.) When symmetry is selected each block in the design will have symmetry as shown here:



Depending on the size of the design and the response to the symmetry option the computer will request a number of colors in a specified range. Enter a choice for the number of colors and then enjoy the interesting design.

The colors that are randomly selected by the computer are displayed at the bottom of the screen as the computer generates a quilt. After all the blocks in the quilt are filled, a new pattern is generated with new colors and the process begins again. (Remember, to stop the program, press any key.) When the program is stopped the question "Generate a new design? (Y/N)" is asked. Respond with 'Y' to start the program over and 'N' to return to the Designs Menu.

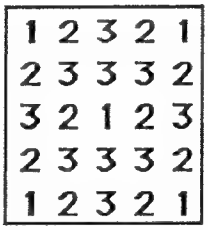
Computer Quilt (Variation)

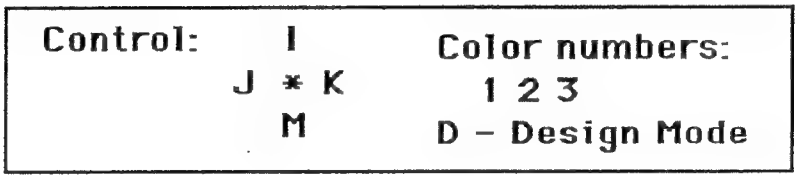
The second tessellation program is a variation of the first. In this program each block of the design has the same pattern but is colored differently. Everything else works like the first tessellation. This program can be used to find particularly pleasing color combinations.

Human Quilt

The third tessellation is titled Human Quilt because the pattern is designed by the user. The first prompt asks for the size of the design. Entries between 2 and 10 are accepted. Next a prompt asks for the number of colors, between 1 and 5. Choosing 1 is useful if the design is to be simply one color and black.

Next the design entry screen will be shown. Use the arrow keys or I, J, K and M to move the cursor about the white matrix showing in the middle of the screen. Enter numbers to show the color pattern that is to be used in the design. The following diagram shows a 5x5 design using three colors.





When the design format is complete press D for the design mode and the computer will generate a quilt using the pattern.

Press any key to stop the program and either begin again or exit to the Design Menu.

Tessellating Shapes

Tessellation #4 uses the high resolution graphics screen. With this program designs can be created using shapes. The designs can be saved and recalled. Up to 9 designs can be saved on the program disk. To see a sample design, press 'G' for 'get' and then '0', for design zero. When the program is first run a strip of shapes appears near the top of the screen. An endless supply of these shapes can be picked up and moved around in the open area below to create a design.

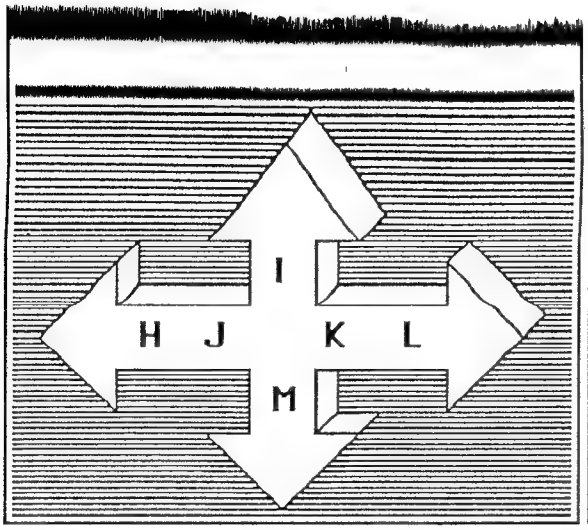
The commands used in this tessellation program are explained in this chart:

Key	Command	Function
N	New	Erases design from screen and memory
C	Clear	Erases design from memory
D	Draw	Draws and "Undraws" design
T	Table	Retrieves a shape table (1-9)
S	Store	Store design file (1-9)
G	Get	Gets stored design (1-9)

The **new** command clears the design portion of the screen and starts the design over by reseting the counter for the shapes. The **clear** command differs from the new command in that the data for the design is erased from memory but the screen is not erased. **Draw** is used to draw and 'undraw' the current design. 'Undrawing' is the Apple XDRAW function where the pixels of a shape are reversed. The **table** command is used to retrieve a shape table from the program disk and thereby change the shapes available in the design. Nine tables of shapes are provided on the program disk and can be used in any design.

The **store** command transfers to one of nine design storage files the information needed to recreate the design. The **get** command retrieves the data from one of the nine design storage files and redraws the design.

To select one of the nine shapes and position it on the screen simply press the number corresponding to the shape. The shape pops out at the middle of the screen and can be moved using the directional control keys. Move the shape and press RETURN when the shape is in the desired position. The shape can be moved using the H, I, J, K, L and M or arrow keys. H and L move the shape ten positions, the other keys only one at a time. The orientation of the shape can be changed using the R key to rotate the shape 90 degrees. Press the escape key, ESC, to cancel the current shape without affecting the design.



[Return]	Put shape at current position.
[R]	Rotate 90^0
[Esc]	Cancel

To 'undraw' a shape, draw exactly the same shape with the same orientation in the same position and it disappears.

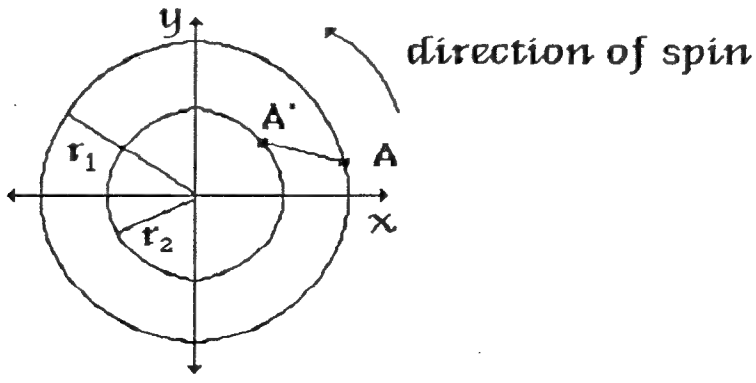
Use Tesselation #4 to create intricate designs of repeated patterns. Activity pages are provided to help guide explorations with this program.

Circle and Line Designs

The Circle and Line Designs are programs that are based on circles and lines. Each program requires that the user define certain values. Based on the values entered a different design is produced. The first program is called Orbiting Points. To leave one of the programs and return to the menu enter 'Quit' instead of a value in response to one of the prompts. Press any key to stop the design and answer the question, "Try this again (Y/N)".

Orbiting Points

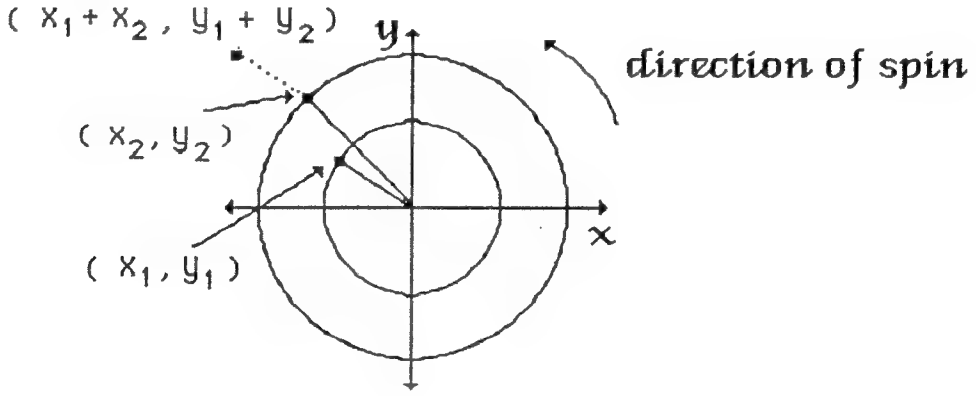
The mathematics used in the program simulates two points moving along concentric circles.



difference in speed at which the points, A and A', are moving relative to each other. A relative speed of 1.0 means the two points are moving at exactly the same number of degrees through their respective arcs. The value for relative speed can be a positive or negative number (either an integer or a decimal). When a negative relative speed factor is entered the point on the second circle orbits in the opposite direction from the point on the first circle. In the world of computer mathematics, the radius of a circle can also be negative. In this program a negative radius causes the circle to begin on the opposite side of a circle with a positive radius and can be useful in the design.

Adding Circles

The second choice from the circle design option generates a design based on the sum of the x and y coordinates for two points orbiting on two concentric circles. The sum of the coordinates is plotted in a continuous line.



The prompts ask the user to enter a radius for two circles and a relative speed factor. Any value with an absolute value less than 80 is accepted for the radii. The relative speed factor can be a positive or negative number. Decimals produce interesting designs.

Strange Curves

This program explores designs that can be produced from straight lines. The first prompt asks for the number of divisions or number of sections along the perimeter. A large number of divisions better illustrates the concept that curves can be produced from straight lines.

Polygon Patterns

This program draws designs based on regular polygons. The first prompt asks the user to select the number of sides. Enter a number for the number of sides. Next, enter the size of the figure. The design is produced by connecting all the vertices of the figure to each other. Interesting designs

can be produced by overlaying designs that are based on different sizes and shapes, so if a new design is generated, the user is given the option to erase or not erase the screen before creating the next design.

Optical Illusions

Four computer graphic optical illusions are provided with GeoArt. To view one of the optical illusions, select option 6 from the Designs Menu and then choose an illusion.

Line Illusion (length)

The first graphic asks the user to compare the length of two lines. Enter an answer to the question, "Which line is longer?" and press return. If the computer does not understand the answer, try rephrasing it.

Size of an Object

The second optical illusion compares the size of two cubes and illustrates how converging lines make objects appear to be different sizes. Enter an answer to the question, "Which cube is larger?" and press return. If the computer fails to understand your answer, try rephrasing it.

A Challenge

Optical Illusion #3 is an impossible figure. It asks the question, "Do you like a challenge? (Y/N)". If the user responds with 'Y' a challenge is given pertaining to the illusion.

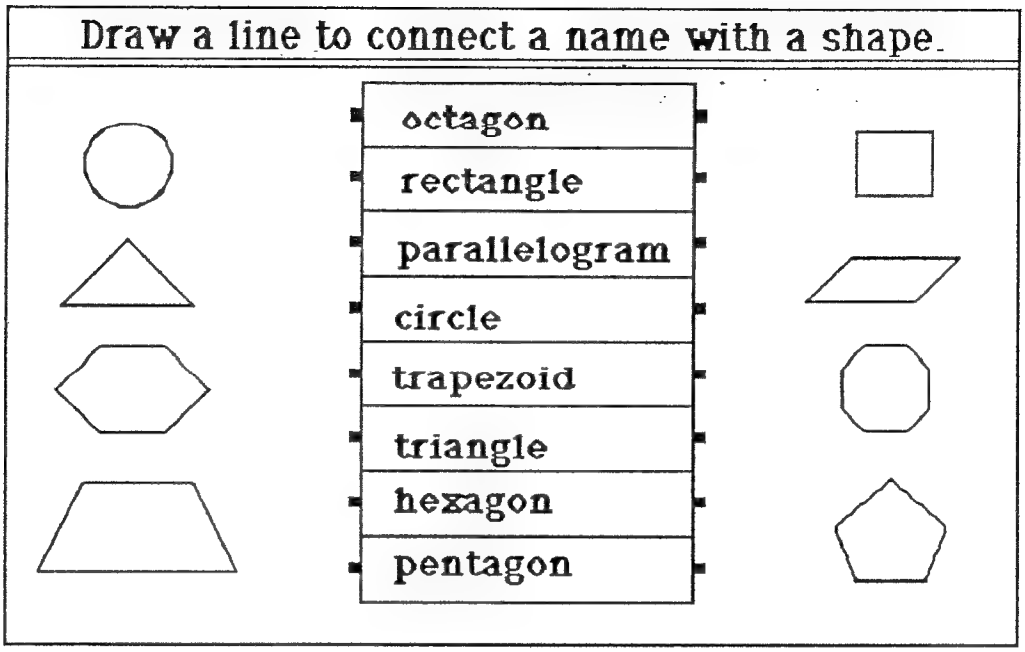
Cube Illusion

The fourth optical illusion appears two ways. It can be viewed as a cube with a piece missing or as a cube with a cube attached.

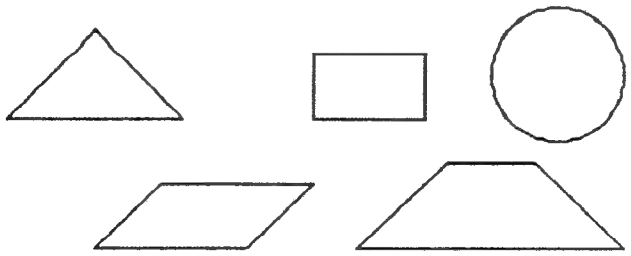
Name _____ Date _____

Activity #1

Shapes Game



These lines are parallel //. Mark an **X** on the shapes with parallel sides.



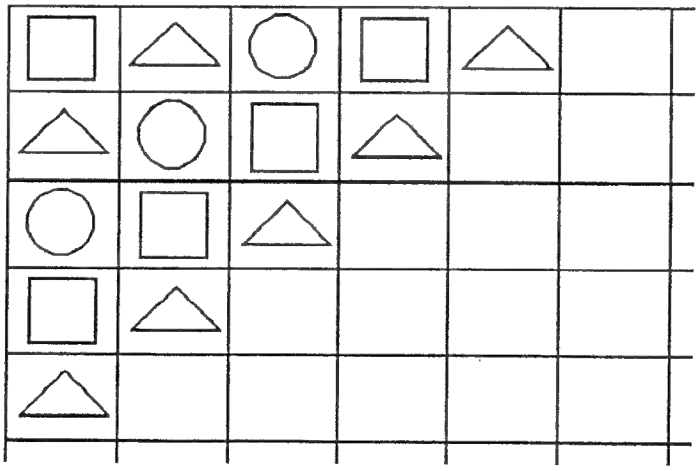
Draw three shapes with at least two parallel sides.

Name _____ Date _____

Complete this chart by writing the name of the shape(s) with the given number of sides.

Number of Sides	Name of Shape
3	
4	
5	
6	
8	

Continue this pattern in all directions.

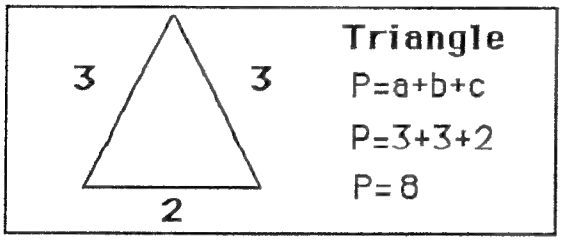


Name _____ Date _____

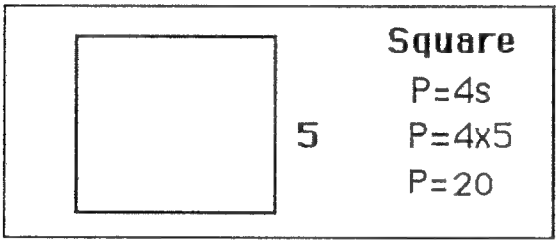
Activity #2

Perimeter Drill

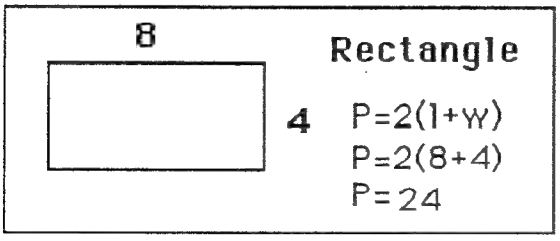
Any figure with three sides is called a triangle. To find the perimeter of a triangle, add the lengths of the three sides.



A square is a special type of rectangle -- all four sides are the same length. To find the perimeter of a square, multiply the length of a side by four.



To find the perimeter of a rectangle, add the length and the width and then multiply by 2.

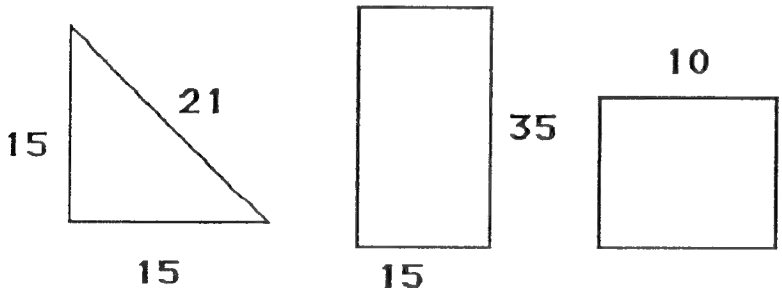


Name _____ Date _____

Find the perimeter of triangles with these measurements:

Triangles			
A	B	C	Perimeter
35	35	20	
44	33	44	
15	20	22	

Find the perimeter of these figures and write your answer inside the figure:



Use a ruler to draw a triangle with a base of 2 inches and a height of 3 inches in the space below. Measure the third side and find the perimeter of the triangle.

Perimeter = _____

Name_____Date_____

Find the perimeter of rectangles and squares with these dimensions:

Squares	
S	Perimeter
22	
16	
35	

Rectangles		
L	W	Perimeter
33	16	
18	19	
12	15	

Super Challenge

The perimeter of this figure is 40 cm. What is the length of side A? _____

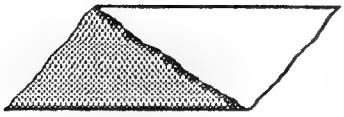
Make a sketch to show the surface of the table where you do you school work. Label the dimensions. What is the perimeter?_____

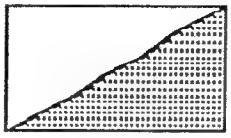
Name _____ Date _____

Activity #3

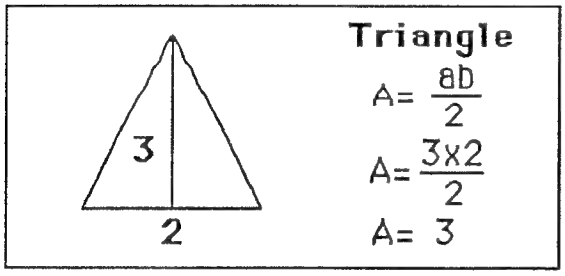
Area Drill

A triangle can be thought of as half of a parallelogram.

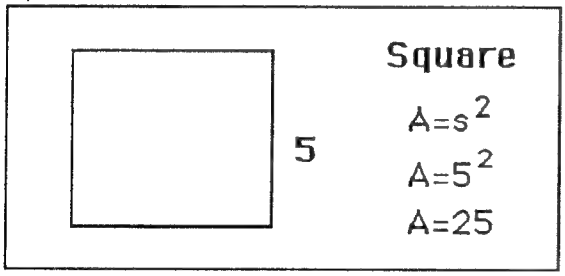




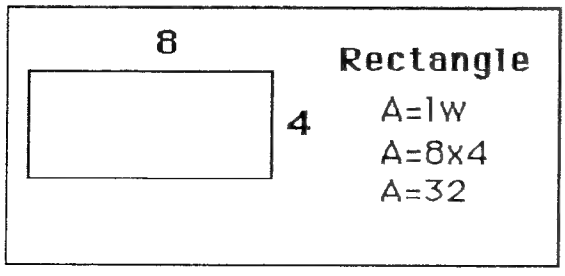
To find the area of a triangle, multiply the altitude and base then divide by two.



In mathematics the term 'squaring' means to multiply a number by itself. To find the area of a square, 'square' the side.



To find the perimeter of a rectangle, add the length and the width and then multiply by 2.

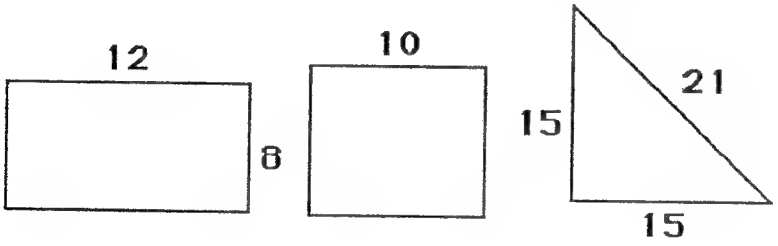


Name _____ Date _____

Find the area of figures with these measurements:

Triangle			Square		Rectangle		
Altitude	Base	Area	Side	Area	Length	Width	Area
16	20		20		16	20	
18	12		12		18	12	
30	10		10		30	10	

Find the area of these figures. Write the answer inside the figure:



Use a ruler to draw a rectangle that is 2 inches by 3 inches. What is the area of the rectangle? __

Name _____ Date _____

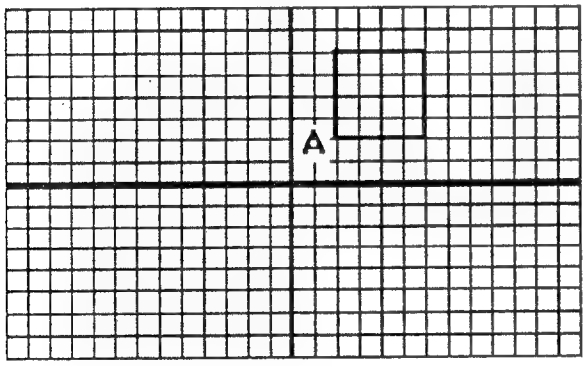
Activity #4

Transformations (Translations)

Choose Transformations from the Main Menu by pressing the number 5.

A translation is a type of transformation where all points of a figure are moved a specified direction. Using the Transformation program we will explore this idea.

Set the screen type for Grid by pressing 1, and set the length of the line segment to 1 unit. Move the starting point to locate point A, the coordinates (2,2), by pressing 'K' twice and 'I' twice, then press return.



A vector is a line segment that has length and direction. Draw a square by entering these numbers for vector codes: 2222 4444 6666 8888.

Imagine what would happen if each point in this figure was moved 5 positions to the right. Sketch on the grid the new figure then press 'H' for horizontal translation and enter 5 for number of points. Compare your sketch with the computer screen. Did you sketch the correct translation?

On the same grid imagine a translation where each point is moved down 8 positions. Sketch the figure that would result. Now press 'V' for vertical translation and enter -8. Compare your answer with the computer.

Name _____ Date _____

Now let's try another horizontal translation. What if the figure is translated 10 units to the left? Sketch your prediction then enter 'H' for horizontal translation and -10 for ten units to the left.

In geometry, translations are described by a number pair. The process is described by saying that the first image maps to the second.

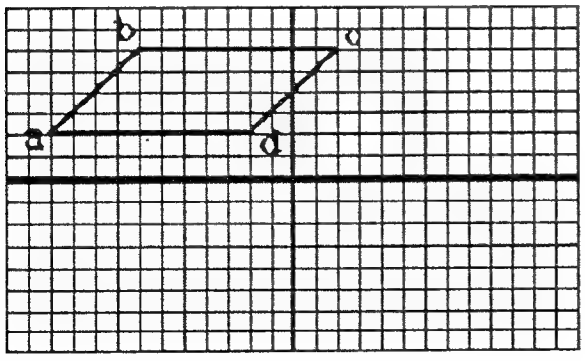
> $\binom{a}{b}$ describes a translation, where a and b are the components.
>
> The image of a point (x,y) under a translation $\binom{a}{b}$ is the point (a+x,b+y).

For example, under the translation $\binom{2}{3}$, the point (2,-1) goes to (2+2,-1+3) or (4,2).

To translate the same figure both vertically and horizontally, enter 'B'. The computer will prompt you to enter both the vertical and the horizontal components of the translations.

Use the 'B' command to translate the figures in these exercises. Press 'C' to clear the grid before each exercise.

Give the coordinates of each point.



	x	y
a	-11	2
b		
c		
d		

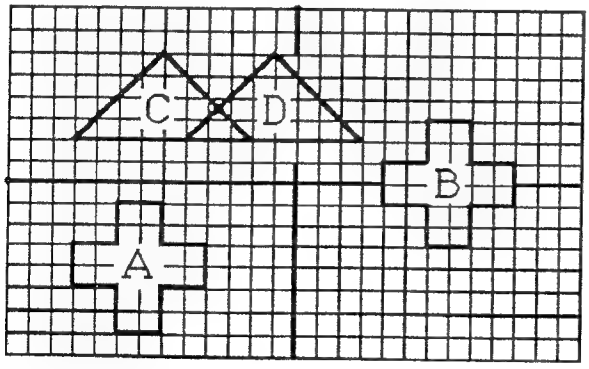
Sketch the figure under the translation $\binom{4}{-3}$.

Name _____ Date _____

Calculate the coordinates of the new figure. Check the calculations by examining the coordinates of the translation on the computer.

	original			new figure
	x	y	calculations	coordinate pair
a	-11	2	(-11+4, 2-3)	(7,-1)
b				
c				
d				

On the grid below two translations are shown. Write the components of the translations using the proper notation in the boxes to the right.



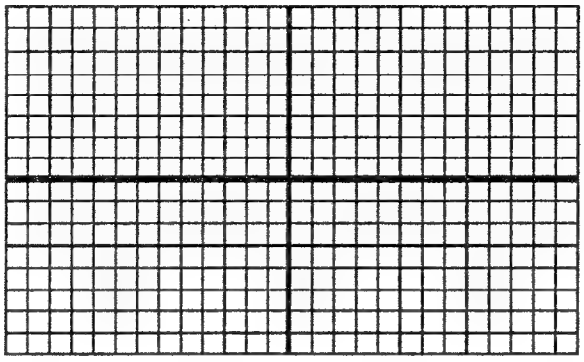
A → B

C → D

Name _____ Date _____

The expression given below describes a translation. Use the program to apply the translation to a figure of your own design. Sketch the figure, then answer each question with 'true' or 'false'.

$\begin{pmatrix} 3 \\ -2 \end{pmatrix}$



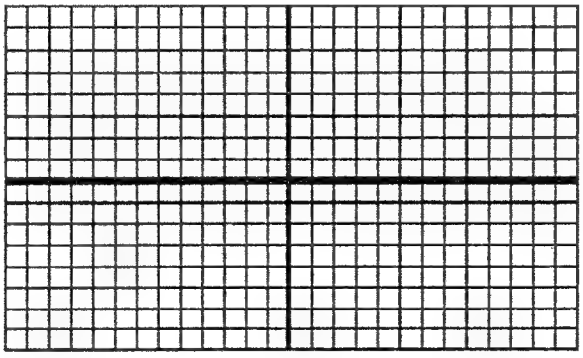
1. _____ All the points in the figure move in the same direction.

2. _____ All the line segments remain the same.

3. _____ The figure and its image are congruent, the same in every way.

Try this experiment again with a different figure. Are the answers to the questions the same?

$\begin{pmatrix} 3 \\ -2 \end{pmatrix}$



1. _____ All the points in the figure move in the same direction.

2. _____ All the line segments remain the same.

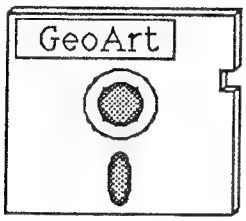
3. _____ The figure and its image are congruent, the same in every way.

Name _____ Date _____

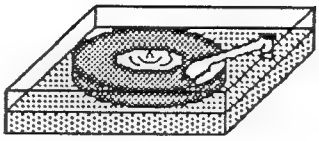
Activity #5

Transformations (Rotations)

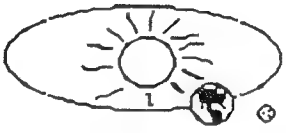
Many of the objects that we find in our world have rotation as the basis of their operation.



Computer Diskette

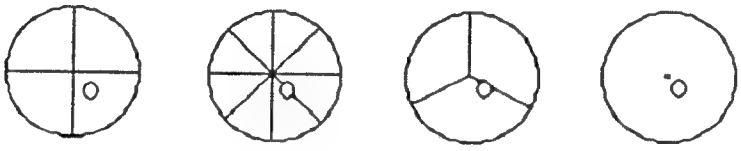


Phonograph

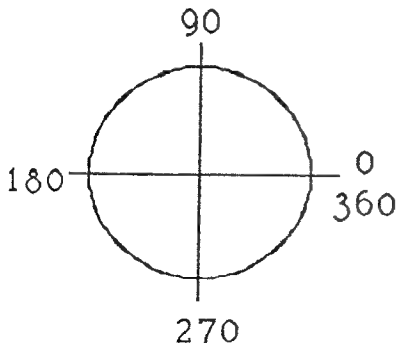


Day and Night

In the diagrams of wheels shown below, spokes are shown. In each wheel the center of the circle is labelled point O. What happens to a point on the wheel as it turns? You could say that the point moves along a curved path called an arc.



The amount that a wheel turns can be measured in degrees.

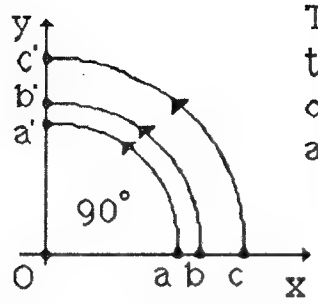


A full turn on a circle is 360°.

A quarter turn is 90°.
A half turn is 180°
and a three-quarters turn is 270°.

Name _____ Date _____

Study the images of three points A, B and C under a 90 degree rotation.

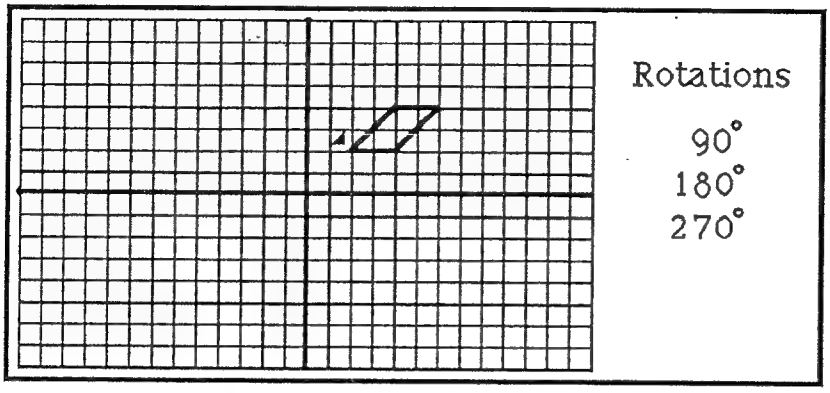


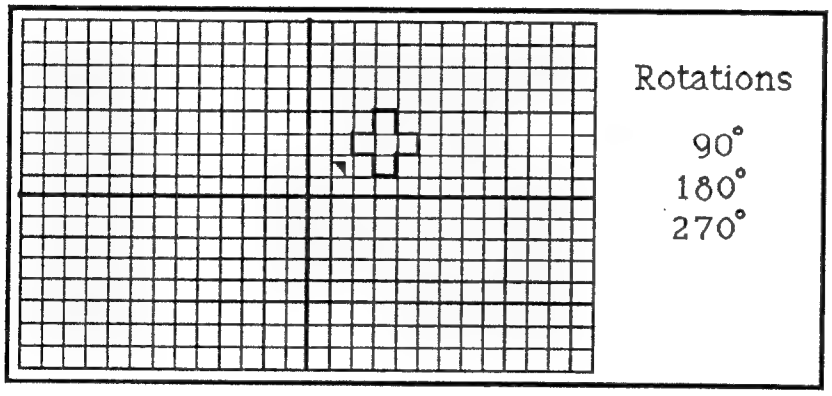
This figure shows the center of the rotation, point O, the direction of the rotation and the size of the angle.

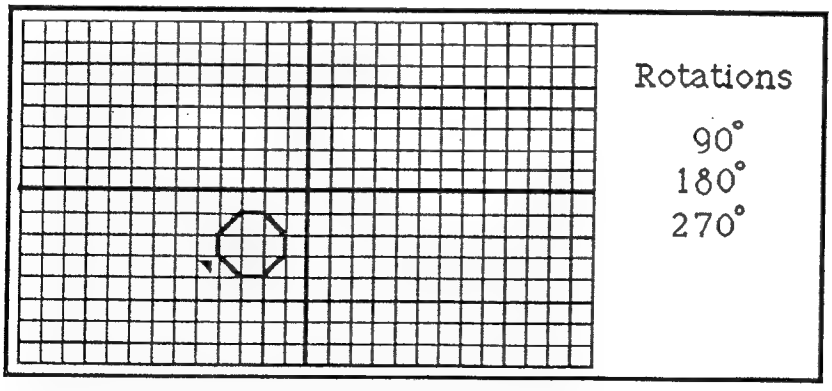
Make a sketch to show what would happen to points a, b, and c under a 180 degree rotation.

Name _____ Date _____

Use the Transformations program to rotate the figures shown on each grid. Select screen type #1 - Grid and a line segment length of 1 unit for these activities. The small arrow points to the starting point for the figure. Sketch the results.







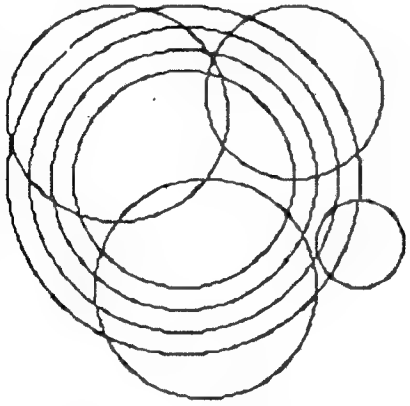
Name_____Date_____

Activity #6

Designs --- Drawing Machine

The Drawing Machine is one of the choices from the Designs Menu. Use the program to explore designs that can be produced form geometric figures.

In the first exercise use the program to draw concentric circles. To create the design select Circle #2, from the menu. Leave the starting point at the center of the screen and draw 5 circles with a radii of 70, 60, 50, 40 and 30.



Add more circles to the design by positioning the center of the new circles on any one of the four concentric circles.

Press 'C' to erase the screen. Try making a design using just rectangles and squares. Using a piece of paper, pencil, compass and ruler duplicate either the design made with circles or the design made with rectangles and squares. Color the design using colored pencils or crayons.

Name _____ Date _____

Activity #7

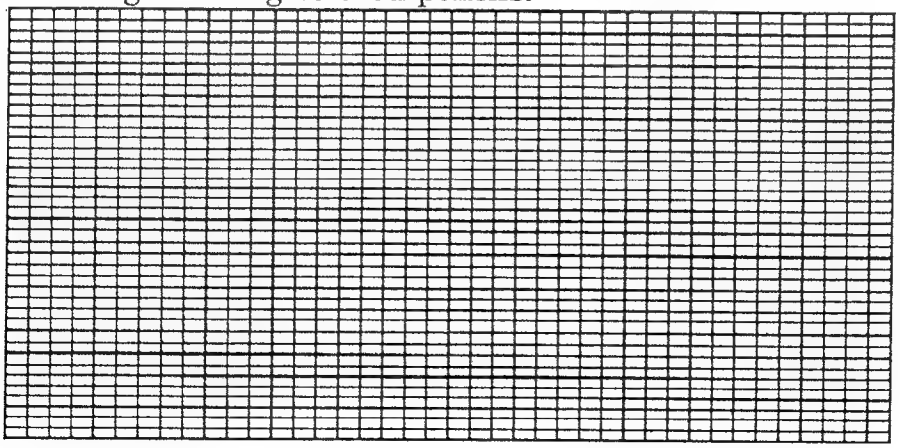
Designs --- Kaleidoscopes --- Diamond Back

After choosing Kaleidoscopes from the Designs Menu four different kaleidoscopes can be selected. Kaleidoscopes 1, 2 and 3 use the low resolution graphics screen. Select Kaleidoscope #1 for the next activity.

After selecting Kaleidoscope #1, the program will request the number of colors. Enter 6, then choose three warm colors and three cool colors from the chart below. Study the warm and cool parts of the design. To stop the program press any key.

Cool Colors	Warm Colors
2 .... Dark Purple	1 .... Magenta
3 .... Purple	8 .... Brown
4 .... Dark Green	11 .... Pink
5 .... Grey (1)	13 .... Yellow
6 .... Medium Blue	
7 .... Light Blue	Black and White
10 .... Grey (2)	0 .... Black
12 .... Green	15 .... White
14 .... Aqua	

Try the program again. This time select either all warm colors or all cool colors. Try the program using just black and white. Try it using all the colors. Enter 'all' to select all colors. Select one of your favorite color combinations and stop the Kaleidoscope program by pressing any key. Copy the design on the grid using colored pencils.

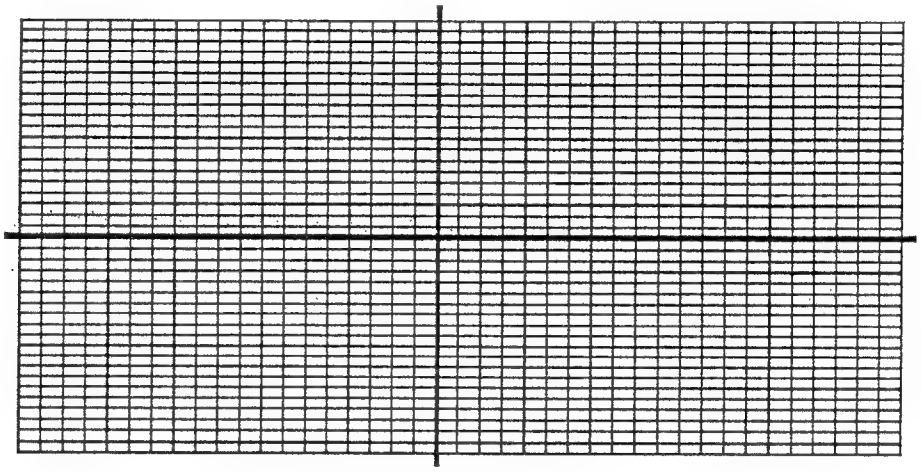


Name _____ Date _____

Activity #8

Designs --- Kaleidoscopes --- Wandering Colors

The second kaleidoscope makes a design by reflecting a point of color. Use this grid and a set of colored pencils to color the top right section of the grid. Reflect the design into the other three sections of the grid to make a design similar to the Wandering Colors kaleidoscope.



Designs --- Kaleidoscopes --- Windows

The third kaleidoscope is titled 'Windows'. Stop the program and copy the design from the screen on to the graphics planning sheet.

Name _____ Date _____

Activity #9

Designs --- Drawing Pad

The drawing pad is used to create low resolution computer graphics. The chart shows the commands that can be used in the drawing pad for creating a picture or design.

Command Mode

B - Select background color
F - Select frame color
M - Move Mode
D - Draw Mode
R - Set reflection mode
P - Instant replay
S - Store graphic to disk
G - Get graphic from disk
[ESC] - Exit program

Move Mode
Directional Control

U	I	O
J	✳	K
N	M	,
	ESC	

Draw Mode
Directional Control

C-Color Select
← → ↵

Reflection Options
1-Horizontal 3-Both
2-Vertical 4-None

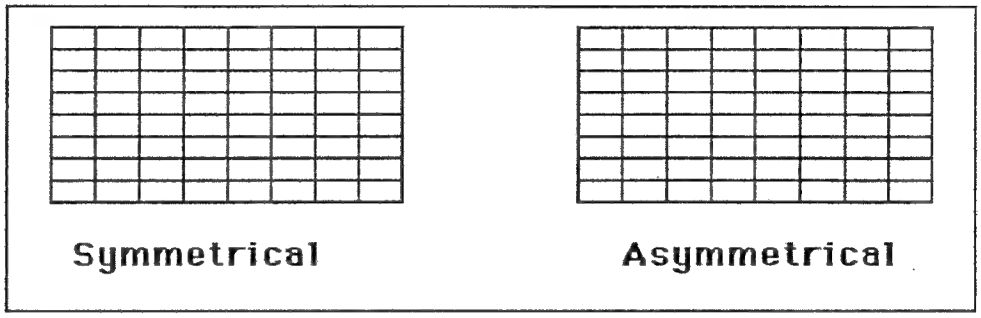
Use large block letters to write your name on the graphics planning sheet. Using the plan make a similar graphic on the computer screen using a single color, then trace around the letters with different colors to make a beautiful design. Press 'G' and enter the name 'Sample' to see a sample of this project.

Name_____Date_____

Activity #10

Designs --- Tessellations --- Computer Quilt

Select Tessellations from the Designs menu and then select #1, Computer Quilt. This program creates a design by repeating a pattern. Enter '8' for the size of the pattern. Next the computer will ask if symmetry is to be used in the design. First answer 'Y' for yes, then later you will answer 'N' for no. Enter '5' to the number of colors question. Stop the design when a pattern that you particularly like is created. Copy the pattern in the grid.



Answer 'Y' for yes to the question, "Generate a new design? (Y/N)". The program will start again. Answer '8' for size of the grid again, but this time select 'N' for symmetry. Enter '5' for the number of color. Stop the design when a pleasing pattern is created. Copy the design using the grid.

Which design do you like better? Why?

Name_____Date_____

Activity #11

Designs --- Tessellations --- Human Quilt

Tessellation #3 is titled Human Quilt because you design the pattern used in making the quilt. The first question asks you to enter the size of the pattern. Enter '5' and press return. Next enter the number of colors. Enter '3' for the number of colors.

When the computer displays the message, Create Pattern..., use I, J, K and M to move within the box and make a layout of one of the patterns shown. When ready press 'D' to start generating the design.

```
3 2 1 2 3
3 2 1 2 3
3 2 1 2 3
3 2 1 2 3
3 2 1 2 3
```

```
3 3 3 3 3
3 2 2 2 3
3 2 1 2 3
3 2 2 2 3
3 3 3 3 3
```

```
3 2 1 3 2
2 1 3 2 1
1 3 2 1 3
3 2 1 3 2
2 1 3 2 1
```

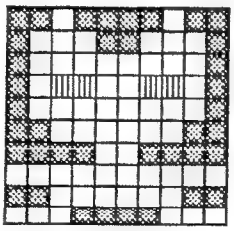
```
3 2 1 3 2
2 1 3 2 1
1 3 2 1 3
3 2 1 3 2
2 1 3 2 1
```

```
1 1 1 2 3
1 1 2 3 1
1 2 3 1 1
2 3 1 1 1
3 1 1 1 2
```

Use a sheet of grid paper and colored pencils to copy the design.

Tessellating Space Creature

Select a 10 X 10 grid and 3 colors for a new tessellation. Layout the design pattern as shown.



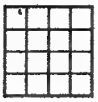
```
1121111211
1222112221
1222222221
1233223321
1122222211
1111221111
2222222222
1122222211
2221111222
```

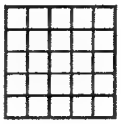
Name_____ Date_____

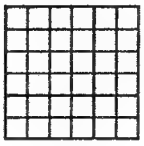
Plan your own designs using these grids. Make some with symmetrical patterns and others with asymmetrical patterns.

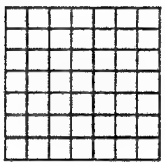
2x2 

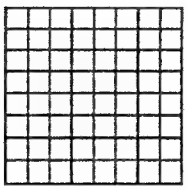
3x3 

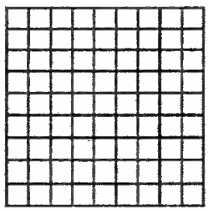
4x4 

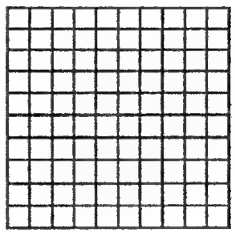
5x5 

6x6 

7x7 

8x8 

9x9 

10x10 

Name _____ Date _____

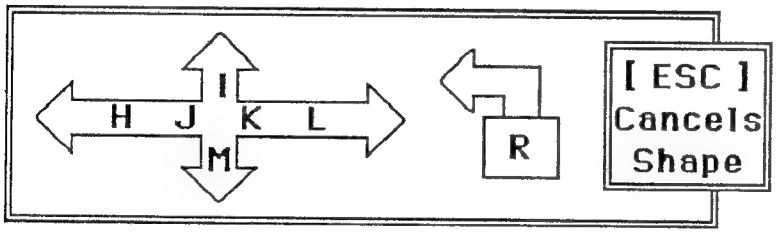
Activity #12

Designs --- Tessellations --- Tessellating Shapes

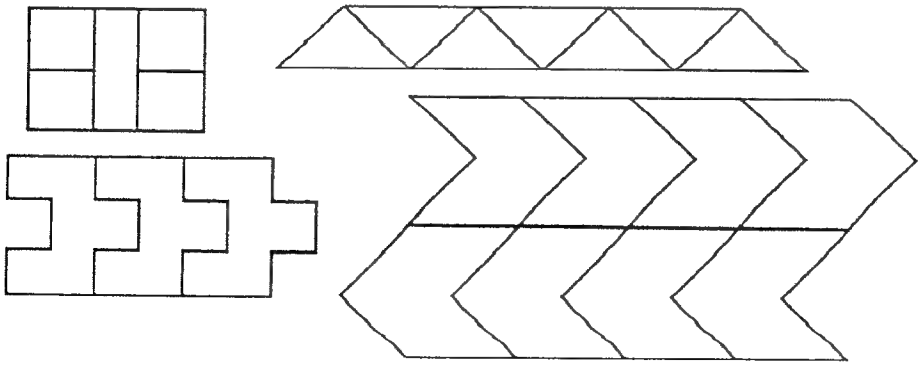
To use the Tessellating Shapes program select #4 from the Tessellations menu. This program allows you to position shapes on the screen to create a design or object.

N	New	Erases design from screen and memory
C	Clear	Erases design from memory
D	Draw	Draws and 'Undraws' design
T	Table	Retrieves a shape table (1-9)
S	Store	Store design file (1-9)
G	Get	Gets stored design (1-9)

To place a shape on the screen, press the number corresponding to the shape. It will appear at the center of the screen. Use the directional control keys to move the shape, press R to rotate shape 90 degrees, and press RETURN to put the shape at the current position and return to the command mode.



To get familiar with the program use the shapes in Table #1 to make the tessellations shown on the following page.



Name_____Date_____

Load Table #3 by pressing 'T' for Table followed by a 3. Make this design using shape #1.

You may have noticed as you completed these activities that if you move a shape exactly on top of itself it disappears. That is because the Apple XDRAW command is used to draw the shapes on the screen. The pixels (dots on the screen) are reversed by the XDRAW command. In other words, if the pixels are ON, they are turned OFF, or if the pixels are OFF, they are turned ON. This feature can be used to create animation.

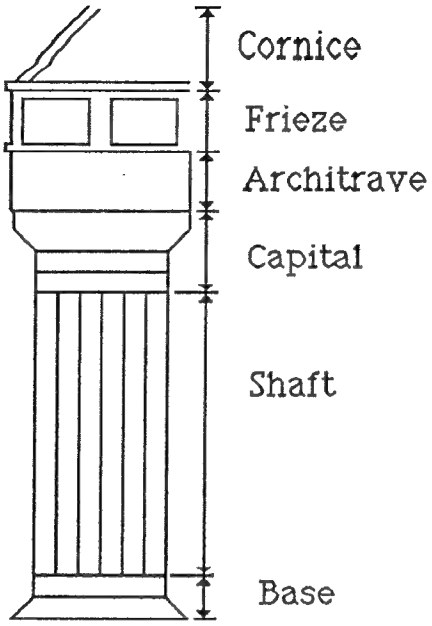
Try this experiment with Table #5. Select shape #1. Then without moving the shape press RETURN to position it. Now select shape #2. Press RETURN. Then select shape #2 again. Notice disappears. Press RETURN, then select shape #3. Erase #3 by selecting it again and pressing RETURN. Select #4, press return and repeat. Select #5, press return and repeat. Now watch the animation effect when you press the 'D' command to redraw the shapes. Try another animation process. The shapes in table #9 can be used for interesting animations.

Table #2 contains some of the pieces needed to make a Greek or Roman temple. Shapes 1, 2 and 3 are examples of classical styles for the capital or top section of a column. Types of capitals represent different architectural styles.

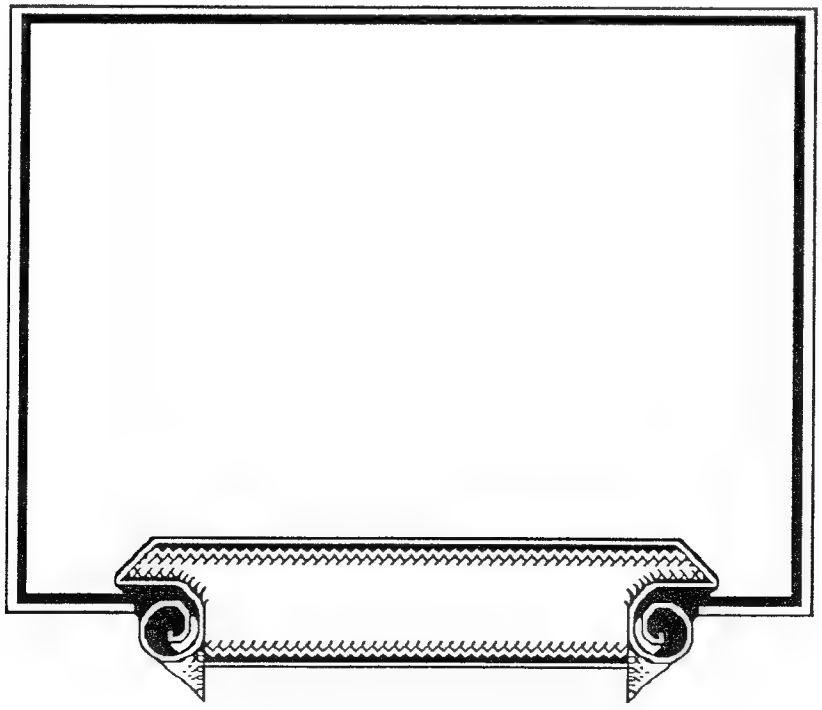
In this activity you will design the front of a temple. Begin by erasing the screen and then select table #2. Shapes 4 or 5 can be used for the base of a column. Select either 4 or 5 and position it as far down on the screen as possible and move it 5 jumps to the left with 'H'. Select shape 6 and use it to create the shaft. Position three pieces of the shaft on the base to make a column. Select a capital (shapes1, 2 or 3) and position it at the top of the shaft. Use shape 8 for the architrave. The frieze can be created from any of the shapes. Try table 3 for making a frieze. After making the frieze switch back to table #2 and use shapes 7 and 8 to make a cornice. Now make more columns to complete the temple.

Name_____ Date_____

Parts of a Column



Make a sketch of the column that you designed in the space below and label it.

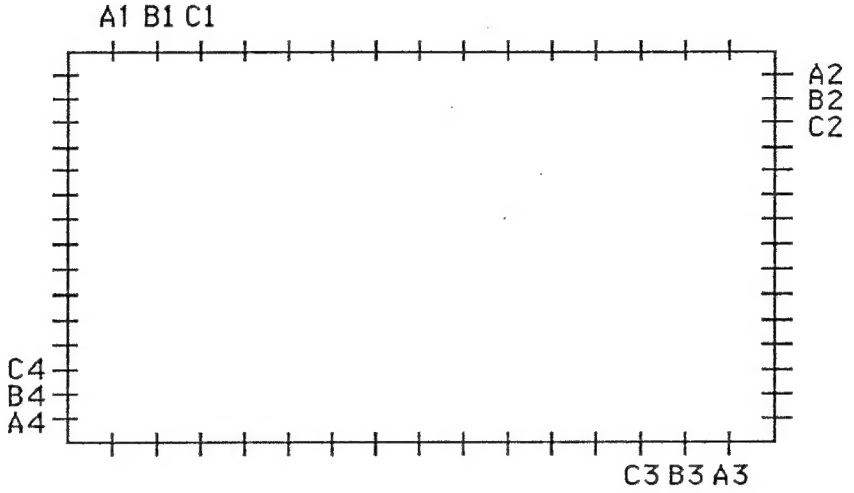


Name _____ Date _____

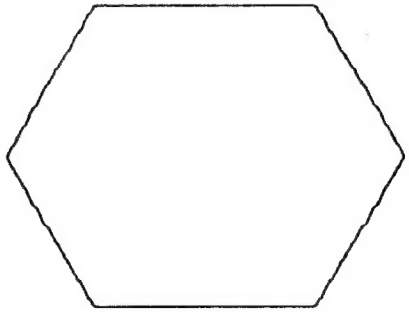
Activity #13

Designs --- Circle and Line Designs --- Strange Curves

Option #5 from the Designs menu is Circle and Line Designs. These programs create designs using circles and lines. In this activity you will explore a design made from straight lines. Use a ruler and precisely draw lines connecting A1, A2, A3, A4 and back to A1. Now connect all the B's and then the C's. Continue the design until all the points are used.



Program #4 from the Circle and Line Designs Menu uses a regular polygon as the basis of a design. Connect all the vertices of the hexagon shown below to make a similar design. Compare your design to the result produced by the computer if 6 sides and a radius of 70 is used.



Name _____ Date _____

Activity #14

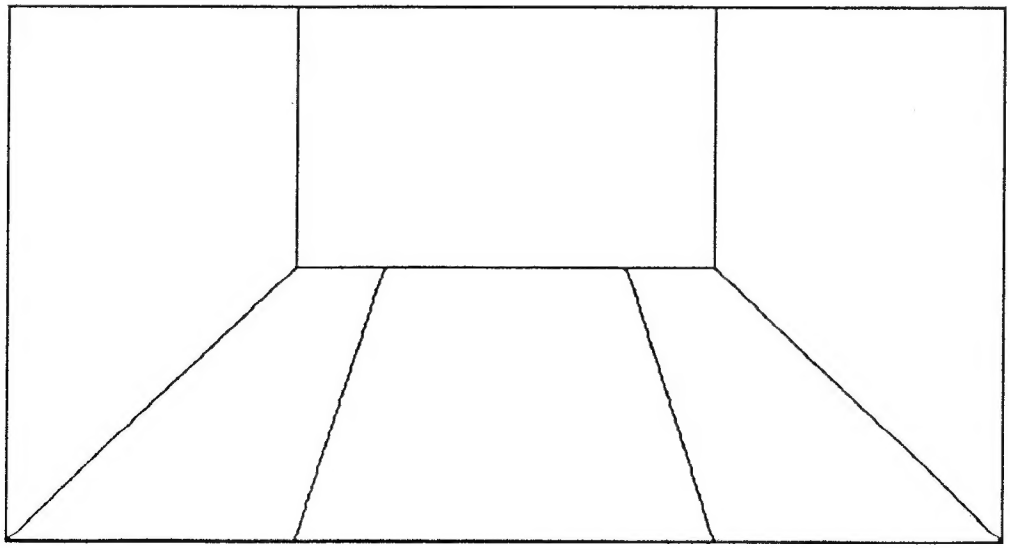
Designs --- Optical Illusions --- Line Illusion

Select #6 from the Designs Menu and then choose Optical Illusion #1, Line Illusion. Study the illusion. Make your own to stump your friends. Draw two lines using a ruler.

Which line is longer?

Draw two identical cubes. Make one at the bottom and the other at the top.

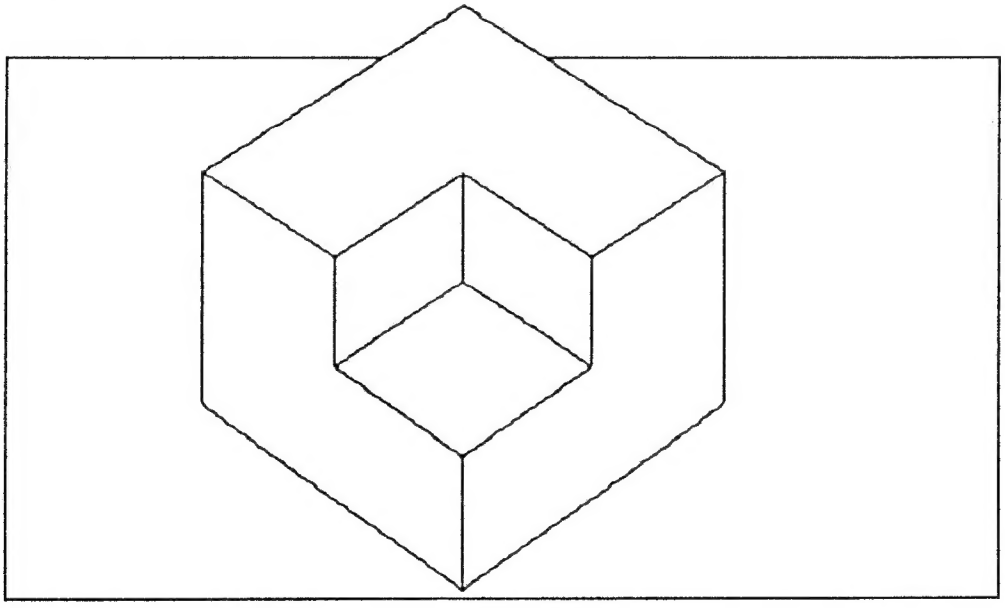
Which cube is larger?



Name _____ Date _____

Try sketching Optical Illusion #3 in the space below.

Part of what makes Optical Illusion #4 effective is the shading. Shade the drawing below to enhance the illusion.



Name_____ Date _____ Graphics Planning Sheet